THE GRAVITY RESISTING ABILITY OF THE CIRCULATION; ITS MEASUREMENT AND SIGNIFICANCE (BLOOD PTOSIS).

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The estimation of the ability of the circulatory apparatus is of considerable importance, both to the physiologist and to the clinician. The heart has been studied extensively and with great care, but the balance of the circulation has not been investigated to the same degree, although modern physiology has recognized the fact that the condition of the circulatory apparatus other than the heart is of paramount importance in the variations of the blood-pressure and the distribution of the blood.

The simplest way to test the circulation is to give it a standardized amount of work to do and to note its reaction to this work, estimating what is normal and what is abnormal by the character or extent of the reaction. Exercises of various kinds have been used, such as hopping a certain distance or lifting weights of a prescribed number of pounds a standard distance at a standard rate, observing the increase in heart-rate and blood-pressure and their return to normal. The Kahn and Barringer tests are examples.

The writer has suggested[1] the use of a standardized load which may be imposed upon the circulation simply and easily and in an entirely natural manner. This consists in observing the reaction of the circulation to the hydrostatic load placed upon it when the subject rises from the horizontal to the vertical position. When the subject is lying horizontal the heart pumps blood, roughly speaking, in about the same horizontal plane and the blood returns to the heart still in this plane without having to be propelled or drawn upward to the heart. On rising to the standing position, however, the blood must return to the heart from the lower body against the attraction of gravity. It must be propelled or pushed from below or drawn from above, upward to the heart level. The mechanism for the accomplishing of this purpose consists in the contraction of the muscles of the legs upon the veins of the legs; the muscles of the abdomen contracting upon the abdominal contents and increasing the abdominal tension; the muscles of the veins themselves, particularly the splanchnic veins of the abdomen, keeping the blood from collecting therein; artificial mechanical contraction of the abdomen, such as may be obtained from belts or corsets; and the aspiration of the thorax increasing as the thorax

[1] Crampton: A Test of Condition, Med. News, September 16, 1905. Blood Ptosis, a Test of Vasomotor Efficiency, New York Med. Jour., November 8, 1913.

is enlarged by breathing or by exercise and decreasing when the thorax is allowed to relax and become smaller. This mechanism is complex and physiologists are not in accord as to the relative significance which should be attached to the tone of the splanchnic veins and the various other factors. The writer is inclined, after consultation with Professors Carl J. Wiggers, Frederick S. Lee and D. R. Hooker, to await the dissection of this phenomenon by the physiologists and for the present to consider the discharge of the series of functions which cause the blood to be returned to the heart in the vertical position as the *gravity resisting ability of the circulation.*

It has been found that this function varied strikingly with the general efficiency of the individual. It is best when the subject is at his best and poor when the subject is tired. It is usually high in good health and low in illness. It records roughly, at least (or possibly with accuracy), the variations of illness and gives promise of showing *how ill a patient is* regardless of the nature of the disease from which he suffers. It is not necessarily a symptom of disease, for it may be abruptly raised and abruptly lowered in a sensitive person by even such a common thing as a cigarette. It varies with the hour of the day and the temperature of the room, the condition of the mind, the state of the digestion and the like. It will vary like the pulse-rate slowly or rapidly, depending upon the external and internal conditions. Since these variations are many and large the writer cannot hope to present a full statement of their significance or the various values of the method of measurement. A few reports of the investigations conducted by other observers who have used this method and some selected observations by the author are, however, significant and will be given.

The Rationale of the Test. The test of the gravity resisting function of the circulation is an estimate of the efficiency of the influences which bring the blood to the heart in the upright position. These are measured in part by the rise of the systolic pressure on standing. The systolic pressure is taken rather than the diastolic, because it consists of both the diastolic pressure and the pulse-pressure: the first, an approximate measure of the tension of the arterial lake and its contents; the second, an approximate measure of the charge of blood thrown into it by the heart at each beat.

To measure the efficiency of the gravity resisting function of the circulation it would appear to be merely necessary to observe the increase in the systolic pressure or its decrease and judge accordingly.

It is true that this in itself apparently is a rough measure and may be interpreted as such. It is important, however, to recognize the fact that an increase in heart-rate *alone* will increase the systolic pressure. Therefore a rise in the systolic pressure on standing may be due in whole or in part to the increase in heart-rate. This increase in heart-rate is not an evidence of the efficiency of the gravity resisting function of the circulation, but quite to the contrary, is an

evidence of a diminution of the amount of blood given to the heart in each beat because the heart can rid itself more rapidly of the small charge than a large one. Increase in heart-rate is further evidence of an increased expenditure of effort on the part of the heart and a decrease of its nutritional efficiency on account of its decreased diastole. We have therefore come to the conclusion that the greater the increase in heart-rate on standing the less the gravity resisting efficiency.

There are therefore two elements to be taken into consideration: the increase in systolic pressure, which connotes efficiency, and the increase in heart-rate, which connotes deficiency.

The observer who wishes to get a clear picture of the circulation should note both the action of the systolic pressure and the heart-rate.

It is difficult, however, to compare two or more ratings in the same or different individuals because of the necessity of balancing the importance of these two factors. For the purpose of record, comparison and statistical handling the writer has devised a scale which balances these two influences and reads a numerical index, giving one value to consider instead of two. In constructing this scale the records of several hundred cases of normal young men were taken, and it was found that the total range of the observations (disregarding the extremes) was from plus 10 to minus 10 mm. Hg of the systolic pressure and from 0 to 44 measuring the increase in heart-rate. Finding these ranges statistically equal they were assigned equal values and each divided into fifty steps, with the fair assumption that these steps were equal in significance. This developed the original scale, which was published on the basis of normal material. Subsequently, however, records from very sick people demonstrated the necessity of extending the scale, both upward and downward, and this was done, using the same measures that had been standardized for normal material. This scale presents a useful and convenient method of stating approximately the value of the efficiency of the gravity resisting ability of the circulation.

In an earlier report the writer suggested the term "blood ptosis" and the term has since been used by Sewall.[2] This term may properly be applied to the condition of the circulation occurring when the gravity resisting ability of the circulation is low, but it should be confined to such meaning. Gravity resistance is a more fundamental term underlying the phenomenon of blood ptosis and the opposite of blood ptosis as well.

In interpreting the scale it would be advisable at the outset to relieve the mind of the notion that 100 is normal and that 0 means no gravity resistance. Such is not the case.

[2] Clinical Significance of Postural Changes in the Blood-pressures, Am. Jour. Med. Sc., December, 1919, No. 6, clviii, 573.

SCALE OF GRAVITY

(Blood Ptosis—

Blood-pressure—Increase.

Heart-rate.	50 to 49	48 to 47	46 to 45	44 to 43	42 to 41	40 to 39	38 to 37	36 to 35	34 to 33	32 to 31	30 to 29	28 to 27	26 to 25	24 to 23	22 to 21	20 to 19	18 to 17	16 to 15	14 to 13	12 to 11	10 to 9	8 to 7	6 to 5	4 to 3	2 to 1
Decrease.																									
— 8 to —12	215	210	205	200	195	190	185	180	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95
— 4 to — 8	210	205	200	195	190	185	180	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90
0 to — 4	205	200	195	190	185	180	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85
Increase.																									
0 to 4	200	195	190	185	180	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80
5 to 8	195	190	185	180	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75
9 to 12	190	185	180	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70
13 to 16	185	180	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65
17 to 20	180	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60
21 to 24	175	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55
25 to 28	170	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50
29 to 32	165	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45
33 to 36	160	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40
37 to 40	155	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35
41 to 44	150	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30
45 to 48	145	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25
49 to 52	140	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20
53 to 56	135	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15
57 to 60	130	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10
61 to 64	125	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5
65 to 68	120	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0
69 to 72	115	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	— 5
73 to 76	110	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	— 5	—10
77 to 80	105	100	95	90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	—5	—10	—15

There are normal men and women with an index as low as 50 and abnormal cases with ratings as high as 120, just as there are normal persons with a pulse-rate from 50 to 80 and many sick persons with the same range. There is no one normal blood-pressure. A patient with arteriosclerosis that has carried a systolic pressure of 200 for several years will give us good cause for alarm when his pressure falls to 120. This is a supposedly normal record, but here it probably means the final break-down of his circulation. Similarly one must not expect to find any one gravity resistance index to be a normal. We can safely say, however, that most persons in good health show an index of from 60 to 100, that a record of over 80 in a person in poor health needs explanation and that a cause should be sought for a record below 50. A record below zero in the minus range is explicit evidence of an impaired circulation, a toxic state or acute severe physical disturbance.

Conduct of the Test. Splanchnic vasotone is measured in the following manner: The sphygmomanometer is adjusted over the brachial artery and the patient is placed on a comfortable couch

RESISTANCE VALUE.

Crampton Value.)

Blood-pressure—Decrease.

0	— 1 to — 2	— 3 to — 4	— 5 to — 6	— 7 to — 8	— 9 to —10	—11 to —12	—13 to —14	—15 to —16	—17 to —18	—19 to —20	—21 to —22	—23 to —24	—25 to —26	—27 to —28	—29 to —30	—31 to —32	—33 to —34	—35 to —36	—37 to —38	—39 to —40	—41 to —42	—43 to —44	—45 to —46	—47 to —48	—49 to —50
90	85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	— 5	— 10	— 15	— 20	— 25	— 30	— 35
85	80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	— 5	— 10	— 15	— 20	— 25	— 30	— 35	— 40
80	75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	— 5	— 10	— 15	— 20	— 25	— 30	— 35	— 40	— 45
75	70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	— 5	— 10	— 15	— 20	— 25	— 30	— 35	— 40	— 45	— 50
70	65	60	55	50	45	40	35	30	25	20	15	10	5	0	— 5	— 10	— 15	— 20	— 25	— 30	— 35	— 40	— 45	— 50	— 55
65	60	55	50	45	40	35	30	25	20	15	10	5	0	— 5	—10	— 15	— 20	— 25	— 30	— 35	— 40	— 45	— 50	— 55	— 60
60	55	50	45	40	35	30	25	20	15	10	5	0	— 5	—10	—15	— 20	— 25	— 30	— 35	— 40	— 45	— 50	— 55	— 60	— 65
55	50	45	40	35	30	25	20	15	10	5	0	— 5	—10	—15	—20	— 25	— 30	— 35	— 40	— 45	— 50	— 55	— 60	— 65	— 70
50	45	40	35	30	25	20	15	10	5	0	— 5	—10	—15	—20	—25	— 30	— 35	— 40	— 45	— 50	— 55	— 60	— 65	— 70	— 75
45	40	35	30	25	20	15	10	5	0	— 5	—10	—15	—20	—25	—30	— 35	— 40	— 45	— 50	— 55	— 60	— 65	— 70	— 75	— 80
40	35	30	25	20	15	10	5	0	— 5	—10	—15	—20	—25	—30	—35	— 40	— 45	— 50	— 55	— 60	— 65	— 70	— 75	— 80	— 85
35	30	25	20	15	10	5	0	— 5	—10	—15	—20	—25	—30	—35	—40	— 45	— 50	— 55	— 60	— 65	— 70	— 75	— 80	— 85	— 90
30	25	20	15	10	5	0	— 5	—10	—15	—20	—25	—30	—35	—40	—45	— 50	— 55	— 60	— 65	— 70	— 75	— 80	— 85	— 90	— 95
25	20	15	10	5	0	— 5	—10	—15	—20	—25	—30	—35	—40	—45	—50	— 55	— 60	— 65	— 70	— 75	— 80	— 85	— 90	— 95	—100
20	15	10	5	0	— 5	—10	—15	—20	—25	—30	—35	—40	—45	—50	—55	— 60	— 65	— 70	— 75	— 80	— 85	— 90	— 95	—100	—105
15	10	5	0	— 5	—10	—15	—20	—25	—30	—35	—40	—45	—50	—55	—60	— 65	— 70	— 75	— 80	— 85	— 90	— 95	—100	—105	—110
10	5	0	— 5	—10	—15	—20	—25	—30	—35	—40	—45	—50	—55	—60	—65	— 70	— 75	— 80	— 85	— 90	— 95	—100	—105	—110	—115
5	0	— 5	—10	—15	—20	—25	—30	—35	—40	—45	—50	—55	—60	—65	—70	— 75	— 80	— 85	— 90	— 95	—100	—105	—110	—115	—120
0	— 5	—10	—15	—20	—25	—30	—35	—40	—45	—50	—55	—60	—65	—70	—75	— 80	— 85	— 90	— 95	—100	—105	—110	—115	—120	—125
— 5	—10	—15	—20	—25	—30	—35	—40	—45	—50	—55	—60	—65	—70	—75	—80	— 85	— 90	— 95	—100	—105	—110	—115	—120	—125	—130
—10	—15	—20	—25	—30	—35	—40	—45	—50	—55	—60	—65	—70	—75	—80	—85	— 90	— 95	—100	—105	—110	—115	—120	—125	—130	—135
—15	—20	—25	—30	—35	—40	—45	—50	—55	—60	—65	—70	—75	—80	—85	—90	— 95	—100	—105	—110	—115	—120	—125	—130	—135	—140
—20	—25	—30	—35	—40	—45	—50	—55	—60	—65	—70	—75	—80	—85	—90	—95	—100	—105	—110	—115	—120	—125	—130	—135	—140	—145

with a low pillow. The heart-rate is counted by quarter minutes and a gradually decreasing rate is usually observed. Counting should continue until two successive quarter minutes are the same; this is multiplied by four and recorded. The systolic pressure is then taken preferably by auscultation. The patient stands, the heart-rate is counted as before until it reaches the "standing normal," when it is recorded, and the blood-pressure is then taken.

Examples.

Case I.—Male, aged twenty-eight years. Physical director; ex-lieutenant, U. S. Marines.

	Systolic.	Diastolic.	Pulse-rate.
Horizontal	125	81	64
Vertical	140	92	76
Difference	+15	+11	+12
Index			+105

Referring to the scale we will find a column under blood-pressure increase, the one headed by the figures 16, 15; following down this

column until we come opposite the line marked on the left of the scale 9 to 12 we find the index 105, which is the desired value for the above record.

CASE II.—Woman, aged fifty-seven years. Uterine fibroid.

	Systolic.	Diastolic.	Pulse-rate.
Horizontal	113	80	68
Vertical	130	78	68
Difference	+17	−2	0
Index			+120

CASE III.—Male, aged fifty-two years. Neurasthenic.

	Systolic.	Diastolic.	Pulse-rate
Horizontal	120	50	88
Vertical	105	55	96
Difference	−15	+5	+8
Index			+30

CASE IV.—Woman, aged forty-five years. Tuberculosis.

	Systolic.	Diastolic.	Pulse-rate.
Horizontal	108	66	90
Vertical	82	54	110
Difference	−26	−12	+20
Index			10

CASE V.—Woman, aged fifty-three years. Dementia.

	Systolic.	Diastolic.	Pulse-rate.
Horizontal	184	88	80
Vertical	100	70	82
Difference	−84	−18	+2
Index			135

These few cases are selected to illustrate the wide gamut of index value from the plus 120 to minus 135. The highest record here given (Case II) is that of a case of uterine fibroid—weak, anemic, irritable; clearly a pathologic overactivated resistance, where we would expect from other symptoms the reverse. This rare condition appears to occur most frequently where there is abdominal pain and irritation apparently nagging the sympathetic system into an abnormally active reaction to the standard physiologic load.

CASE I.—The athletic young man is simply tingling with vigor and his circulatory resistance is more than commonly active. The best boxers, wrestlers, runners and long-distance bicycle riders when in good condition show a value of from 80 to 100.

CASE III.—Is a typical neurasthenic with a typical fall in systolic pressure and a rise in pulse-rate (a little less than common),

a mild degree of blood ptosis. Neurasthenics most commonly show a record of plus 50 to minus 10.

CASE IV.—Is a typical picture of the pretubercular state. These cases almost always show a systolic pressure of 100 to 110 horizontal, and a fall of from 10 to 25 mm. on standing—the diastolic also falls, but following custom, it falls less than the systolic. This class of cases usually show an index of from plus 30 to minus 30.

CASE V.—This is an extreme blood ptosis indicating a profound disability of the nervous control of the circulation which curiously was structurally intact. This case was followed for some weeks and retested frequently and her indices varied from minus 80 to minus 150.

Zero and minus records are not uncommon. They may be obtained by any physician who can and will keep a very sick patient on his feet long enough to take the necessary readings. They occur, however, in ambulant cases where the circulation has become habituated to its disabilities. The lowest reading the writer has recorded is as follows:

CASE VI.—Woman, aged fifty years. Diabetes.

	Systolic.	Diastolic.	Pulse-rate.
Horizontal	178	84	80
Vertical	88	50	96
Difference	−90	−26	+16
Index			165

Retest, third day after.	Systolic.	Diastolic.	Pulse-rate.
Horizontal	152	86	80
Vertical	80	58	88
Difference	−72	−28	+8
Index			110

The Gravity Resistance in Various Diseased Conditions. Gravity resistance records were taken on every patient entering the sanitarium. The average of the indices for each class of cases, with the number of cases in each class, is given in the table on p. 728.

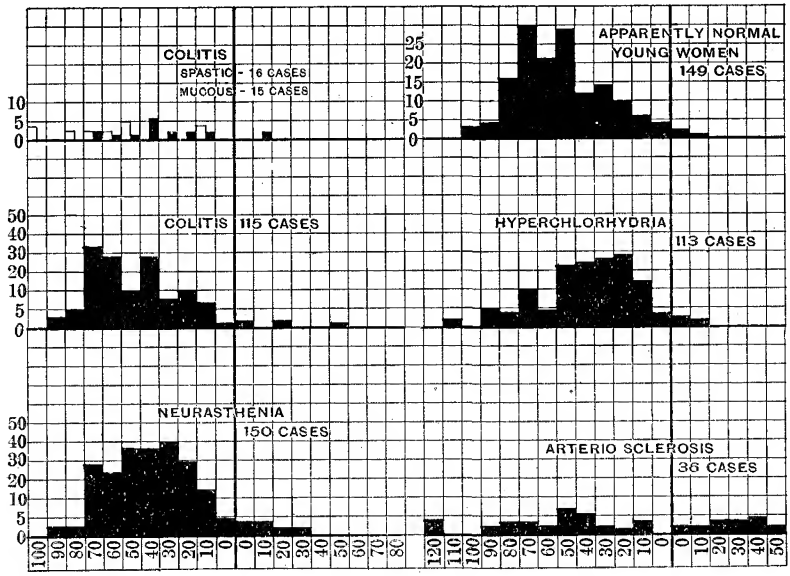
From these figures it is apparent that there is a tendency for certain diseased conditions to be associated with indices that are higher or lower than others. Differences in averages, however, grade by very easy steps from one condition to another, and it is apparent that the hopeful clinician who sees in the gravity resistance index an invariable diagnostic sign will be disappointed.

The importance of the above schedule is at present somewhat limited. The statistical method may be applied to a still larger number of cases and we may be able to state with certainty, for instance, that hyperthyroidism exhibits a standard average index of 60, while migraine shows a value of 52 and pellagra 40. This

might possibly be of importance to the practising physician, but of undoubted importance to the clinician is the fact that the index varies greatly in each diseased condition. For example, in a series of nine cases of paralysis agitans the highest index is 85, the lowest 15; of 105 neurasthenics, the highest is 90 and the lowest is − 165. We venture to suggest that these tremendous differences in circulatory function are quite as important to the physician and to the patient as the diagnosis itself, and possibly more so, for they give one indication at least of *how sick he really is*.

Number of cases.	Diseased condition or most prominent symptom.	Index.
22	Rheumatism	78.8
7	Hyperthyroidism	60.7
12	Irritability	60.7
12	Hay fever	57.0
5	Cholecystitis.	57.0
9	Dysmenorrhea	53.8
37	Obesity	53.3
6	Hypothyroidism	52.0
54	Migraine	51.9
3	Arthritis	51.0
15	Colitis (spastic)	51.0
65	Secondary anemia	49.0
17	Nephritis	49.0
12	Carcinoma	48.0
8	Cystitis	48.0
13	Hysteria	48.0
4	Gastric ulcer	48.0
11	Cystocele	47.0
20	Mitral stenosis	47.0
5	Asthma	46.0
115	Colitis	46.0
23	Hypochlorhydria	46.0
46	Asthenia	45.0
28	High blood-pressure	45.0
105	Neurasthenia	45.0
83	Hyperchlorhydria	43.0
7	Sciatica	42.0
6	Neuralgia	41.0
7	Duodenal ulcer	40.0
2	Vertigo	40.0
34	Arthritis deformans.	39.0
25	Lues	39.0
25	Neuritis	39.0
15	Colitis (mucous)	38.0
54	Myocarditis	38.0
3	Pellagra	38.0
37	Arteriosclerosis	37.0
21	Mitral insufficiency	36.0
39	Insomnia	33.0
17	Pulmonary tuberculosis	33.0
12	Chronic appendicitis	31.0
8	Paralysis agitans	31.0
8	Albuminuria	28.0
24	Mental depression	25.0
2	Paresis	17.5
15	Splanchnoptosis	12.6
14	Cardiovascular renal complex	14.6
6	Angina	−3.0

A preliminary study of the distribution of the indices in disease groups, reveals the fact that in the case of some diseases there is little variation, in others there is much.



Reference to the charts will indicate that 115 neurasthenia cases are grouped closely about plus 20 to plus 70 range, while 36 arteriosclerosis cases range loosely from plus 120 to minus 50. In 115 colitis cases there appears distinct evidence of bimodality in the plotted curve, indicating the presence of two groups of colitis cases reacting differently in gravity resistance. One group centers about plus 60 and 70 and another has an indication of a mode about 40. The distribution of a few cases of colitis, one diagnosed as mucous and the other as spastic, plotted above the colitis curve, suggests the possible explanation that spastic colitis cases show a high gravity resistance and other colitis cases lower.

The distribution of cases of arteriosclerosis also suggests the inclusion of subgroups under one diagnostic head. In this case, there are three groups suggested, centering respectively at plus 120, plus 60 and minus 40. It is quite possible that there are three corresponding disease conditions coinciding with these modes. It is quite certain that those cases of arteriosclerosis with indices below zero are suffering from a severe disability of the gravity resisting forces of the circulation. It is equally clear that the four cases with indices of 120 and over have their gravity resisting forces in a hyperefficient state. The clinical significance of these striking facts is not as yet known. The foregoing is merely a preliminary entrance into a most fascinating and unworked field in medicine.

Physiologic and Other Clinical Variations of Gravity Resistance Ability. In the experience of the author, young men in good physical condition have high indices, running, as a rule, from 70 to 100. Dr. R. Tait McKenzie, of the University of Pennsylvania, reports from records taken from the University of Pennsylvania crew the average of 116 observations:

	Systolic.	Pulse-rate.
Horizontal	116.6	77.2
Vertical	115.5	85.2
Difference	−1.9	+8.0
Index		65

This index is lower than could be expected in young men prepared to enter a severe test of endurance. It reflects, however, exactly the condition of the circulation at the time. It is quite possible that men in athletic training become fatigued in circulatory control, a fact which may account for many hitherto unexplained defeats in athletic contests.

Under standardized conditions this value is an accurate indication of the "condition" of the athlete.

Mr. C. H. McCloy, instructor in physiology of exercise in a Young Men's Christian Association, and an athletic coach (reports unpublished), says that after he had standardized his athletes by establishing an initial correlation between their athletic performance and the index, it proved an exceedingly reliable measurement for the type of condition which varies from day to day.

"I could tell with fatal accuracy this individual's condition relative to his general condition at the time. If there was any doubt as to which individuals should play the basket-ball game (many thus of almost equal scale and endurance), this test was of exceeding value in determining relative condition of this individual.

"I found, furthermore, that the condition producing a high index was not only conducive to good performance, as to endurance, nervous speed and strength, but was exceedingly accurate in determining skill as well. Thus, for example, I have become somewhat able to predict accuracy and inaccuracy in basket-shooting for basket-ball players. In testing baseball pitchers I was even enabled to predict at times, with relative certainty—after I had experimented with the individual and gotten his personal equalization—about how many hits and runs would be made off of him when I knew the general ability of the other team.

"The explanation of all of this seems to me to be tied up very closely with the relationship of splanchnic tension to the present condition of the individual. The presence of fatigue poisons, results of auto-intoxication of any sort or of latent or active infection would show itself immediately in lack of splanchnic tone and power of recovery upon resuming the upright posture."

In other words, he found that though his athletes differed from each other in index, yet their variations from their own individual standards were strikingly parallel to motor efficiency of the athletic type. In my own earlier work with athletes I had the same experience, but not to the degree reported by McCloy.

Aviators have been tested at the Experimental Laboratory of the Air Service at Mineola, New York, under Major Edward C. Schneider. He has communicated to the author data (as yet unpublished), showing a striking coincidence of values and the results of various other tests. He grouped the aviators into four classes in accordance with their reaction to medical and psychologic tests, including the rebreathing low oxygen test, the rotation test, reaction time, etc., and used the author's index.

His four classes and their corresponding average gravity resistance is given as follows:

Aviation class.	Index.
AA	88.75
A	68.25
B	57.00
C (5 cases only)	68.13

Schneider also records a fall in value in 65 per cent. of cases after flying; in some cases this amounted to 30 per cent. The indices clearly suggest a correlation with physical condition.

Norris and Lane have reported a brief study of "vasotone," using our method,[3] with the following results:

	Average.	Lowest.	Highest.
Class A (10 heart cases):			
Before compensation	62.5	35.0	75.0
After compensation on getting out of bed after three or four weeks' rest and treatment	93.6	80.0	100.0
Class B (58 convalescent cases):			
On classification as convalescents after illness	45.9	10.0	67.0
After four weeks' additional treatment	81.0	40.0	100.0
Class C.:			
A group of apparently well persons	79.3	55.0	100.0

The high record 93.6 made by the heart cases after rest indicates the striking improvement in what is usually called "general condition" under treatment. It also indicates the fact that the structural and functional factors in the circulation may vary independently, and where the structural factors cannot be changed the functional may.

In a most clear-cut report of an excellently planned investigation, Smith,[4] of Los Angeles, using the author's scale, relates the "vaso-

[3] Arch. Diag., July, 1917.
[4] Jour. Am. Med. Assn., No. 3, vol. xi.

tonic" condition of a series of 500 recruits, which passed through his hands. He gives an average index of 86.9 for 500 men. He also observed low indices, plus 52, in a recruit two days before he became sick with measles and plus 92 on recovery. This recalls a case of a young athlete, found upon examination for admission to college athletics to have inexplicably low indices, and reporting sick a day or so later. The author has previously reported cases of this kind.[5] It is clear that one can only stumble on these cases occasionally in the course of routine examination. It is quite clear that a sudden drop in index may mark the *onset of acute disease before any other symptom is present.*

An interesting case that has come under the author's notice is that of a colleague at the Battle Creek Sanitarium who had been used as a subject for a study of vasotone variations.

Date.	Hour.	Feelings.	Systolic.	Diastolic.	Pulse.	Index.
Aug. 20, 1919	8.45 A.M.	Fine	H. 170	110	80	
			V. 173	108	84	
			+3	−2	+4	85
Aug. 21, 1919	9.10 A.M.	Depressed	H. 176	104	80	
			V. 168	116	84	
			−8	+12	+4	55
Aug. 22, 1919	9.30 A.M.	Good	H. 170	105	84	
			V. 180	120	84	
			+10	+15	0	100
Aug. 24, 1919	9.00 A.M.	Dizzy, nauseated and feeling ill	H. 134	80	84	
			V. 106	80	108	
			−28	0	+24	−20

This patient was sick during the day and for some time afterward with a digestive and nervous collapse. He returned to his usual range of index, 40 to 90, on recovery.

In this case it will be noted that there was an actual fall of the vertical pressure. This is not always the case, for the index may fall as the pressures rise. The same subject showed the following record:

Date.	Hour.	Feelings.	Systolic.	Diastolic.	Pulse.	Index.
Aug. 14, 1919	3.35 P.M.	Rested after nap	H. 166	110	68	
			V. 171	105	72	
			+5	−5	+4	90
Aug. 14, 1919	5.05 P.M.	Excited; "rushed"	H. 184	123	66	
			V. 180	115	66	
			−4	−8	0	65
Aug. 14, 1919	6.10 P.M.	Still rushed and excited	H. 188	115	68	
			V. 172	118	72	
			−16	+3	+4	35

[5] Med. News, op. cit.

In this instance, excitement, work and the tension of hurry raised the systolic pressure (especially the horizontal) but progressively lowered the gravity resistance. These records illustrate the fact that gravity resisting ability varies independently of the actual blood-pressures.

The index has been used by Goldberger,[6] under the writer's direction, to ascertain the effect of work days and holidays upon "vasotone." The following results were obtained:

	Number of cases.	Average change.	Greatest increase.	Greatest decrease.
Fatigue of one school day	13	−9.3	+10.0	−27.5
Recuperation over week-end	13	+1.7	+37.5	−40.0
Recuperation during Easter holidays	13	+3.6	+27.5	−37.5
Depreciation January 22 to March 25	13	−7.3	+40.0	−32.5

Recuperation, 53 cases, summer vacation, June 24 to September 15.

	Average change.
First group, nine to ten weeks spent in country	+13.7
Second group, four to eight weeks spent in country	+14.3
Third group, one to four weeks spent in country	+8.3
Fourth group, taught summer school	−20.8
Fifth group, ill during the summer	−16.7

These figures present striking pictures of the effect of rest and recuperation in contradistinction to work and illness and open a primary field of research in industry.

Another valuable research which throws light upon the effect of working conditions upon efficiency has been made by the New York State Ventilation Commission.[7] They made thirteen different physiologic records, including the index, and report as follows:

"A very high room temperature, such as 86° F., with 80 relative humidity, produces slight but distinct elevation of body temperature, an increase in reclining heart-rate, an increase in the excess of standing over reclining heart-rate, a very slight lowering of systolic blood-pressure and a marked fall in the "Crampton value."

The final summary is as follows:

Temperature.	Air.	Crampton index.
68° F.	Still	+60.0
75° F.	Still	+45.0
86° F.	Stirred by fans	+40.0
86° F.	Still	+35.0

This indicates the tonic effect of cool air and the blood ptosis producing effect of hot air, particularly when still.

Tobacco. The effect of tobacco upon the gravity resistance ability is often quite marked. A single subject was carefully stand-

[6] Teachers' Vitality as Indicated by the Blood-ptosis Test, New York Med. Jour., April 29, 1916.

[7] Some Results of the First Year's Work of the New York State Ventilation Commission, Am. Jour. Public Health, No. 2, vol. v.

ardized for a period of a week. He was thirty-five years old, in the diplomatic service of the United States, a neurasthenic and had been an occasional heavy smoker, when called upon for long-continued work. His customary gravity resistance index was +20 to +60. He had not smoked during the previous week.

	Systolic.	Diastolic.	Pulse-rate.	Index.
Room temp. 73° at 11.00 A.M.	H. 112	60	72	
	V. 106	74	100	
	−6	+14	+28	+30
Cigarette given 11.20 A.M.	H. 134	75	92	
	V. 114	80	110	
	−20	+5	+18	+5
Dizzy, asked to lie down, 11.30 A.M.	H. 114			
	V. Below 70 (by palpation. No sounds heard).			
	Patient would not or could not stand.			
	Insisted on lying down; profuse perspiration; nauseated.			

This is the clear picture of tobacco sickness and is typically a blood ptosis. Unfortunately the observer could not get the pulse-rate, or follow the systolic pressure down below 75. The index was probably between minus 60 and minus 80, and going down. The experiments were made in the bath treatment room, with the temperature at 73° and the humidity over 80. This is noteworthy, for the temperature was lowered to 57° to 60° the next day and strikingly different results were obtained, as follows:

	Systolic.	Diastolic.	Pulse-rate.	Index.
11.00 A.M., temp. 57°	H. 132	84	72	
	V. 134	86	72	
	+2	+2	0	80.0
11.13, lit cigarette	...	...	78	
11.13½	...	...	88	
11.14½	...	...	92	
11.15½	H. 146	90	96	
	V. 170	104	96	
	+24	+14	0	135.0
11.21	H. 148	90	88	
	V. 162	98	88	
	+14	+8	0	110.0

The resistance was quite high, (80) before smoking, due to the temperature effect, quite in accord with the New York State Ventilation Commission findings. Under this stimulus the cigarettes acted

very differently from the day before. The systolic pressure, 20 points higher than the day before to begin with, rose abruptly 14 mm. in the horizontal position and 26 in the vertical, with both diastolic pressures and pulse-rates increasing, whereas, under the hot, heavy, humid atmosphere of the day before, the bottom literally dropped out of the pressures. This experiment, although unrepeated, is reported because of its striking demonstration of variations in gravity resisting ability. It is, of course, only a single case and should be evaluated as such. It is submitted in the hope that others may be in a position to make similar tests.

In the opinion of the writer the subject was sensitized to the effect of tobacco because of his previous overindulgence and had developed a tolerance to its toxic effects. This tolerance was broken down by the removal of its customary stimulation and left the system peculiarly sensitive to the effect of the tobacco.

RECORDS BEFORE AND AFTER TONSILLECTOMY.

		Number of days after operation.				
Case No.	Before operation.	1	2	3	4	5
I	70	55	50	50	60	
II	85	25	20	65	80	75
III	105	60	..	..	..	60
IV	40	50	40	55	50	
V	55	45	30			
VI	50	35	50			
VII	75	90	75	50	55	80
VIII	30	20	40	25	35	30
IX	80	95	60	30	30	20
X	75	55	70	80	90	
Average	66.5	53	48.3	50.7	57.4	53.0

These few cases show certain points of interest. The average show a decrease after operation, the lowest point resting on the second day. The reaction of individuals varies. Cases IV, VI and VIII were low and lost little in circulatory power. The highest records, notably Cases II and III, lost the most. Two cases (VII and IX) actually increased in resistance power only to fall to low records on the third day. Case VII recovers on the fifth day while Case IX continues low. It is of interest to note that he suffered from kidney disease and was sick enough to be returned to the hospital on the fifth day (with an index of 20) for further treatment.

There have appeared in medical reports from time to time, in medical literature, various statements as to the reaction of the blood-pressures on rising from the horizontal to the vertical position. For example: "The systolic always falls on 'rising;'" "the diastolic always rises on standing;" "the pulse pressure always decreases on rising from the horizontal to the vertical." The action of the systolic pressure and the reasons for the action are discussed in this

communication. The bare facts from over seven hundred cases are given below:

EFFECT OF RISING FROM HORIZONTAL TO VERTICAL POSITION.
Patients entering the Battle Creek Sanitarium.

	Number of cases.	Per cent.	Total cases.
Diastolic:			
Rises	403	54	
Falls	336	46	739
Systolic:			
Rises	109	15	
Falls	639	85	739
Systolic rises; diastolic rises	83	11	
Systolic rises; diastolic falls	26	4	
Systolic falls; diastolic rises	320	43	
Systolic falls; diastolic falls	310	42	739
Pulse-pressure increases	78	11	
Pulse-pressure remains the same	70	9	
Pulse-pressure decreases	593	80	741

These figures will hold true for this class of cases. The proportions will vary from these standards in every group of cases studied, depending on the degree of illness and its nature.

Summary. 1. The horizontal and vertical blood-pressures may differ greatly in the same individual.

2. A rise in systolic pressure on standing indicates efficiency in the gravity resisting ability of the circulation; a fall, the reverse.

3. The increase in heart-rate on standing indicates inefficiency in the gravity resisting ability of the circulation in proportion to the increase.

4. Taking both influences into consideration, an index may be determined for convenient use.

5. This index is lowered by various influences among which are fatigue, toxins, the approach of disease and disease itself.

6. This index may be high in good health and also in some diseased conditions.

7. The index may prove helpful in estimating the extent illness is damaging the circulation in the course of disease and in estimating the progress of recovery.

8. This index may indicate the fatigue and the variations of condition in an athlete.

9. The normal range of this value is approximately from 50 to 100, although records in this range may be given by sick persons, but high records in sick persons are probably evidences of pathologic overtone.

10. Records below zero are evidences of great lack of circulatory power.

11. Comparison of records of two individuals may or may not

give much information. Successive records on the same case may give more.

12. The customary single recording of the blood-pressure in one position gives no information as to the gravity resisting function of the circulation.

PERNICIOUS ANEMIA: A STUDY OF ONE HUNDRED AND FORTY-EIGHT CASES.

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The study embraces a total of 148 cases discharged from the Cook County Hospital under the diagnosis of pernicious anemia, which may be divided into two main groups: (1) those in which the diagnosis was purely clinical, and (2) those in which the diagnosis was confirmed or corrected at autopsy. There were 22 of these latter. Of the other cases, 126 in number, 112 may be accepted, on the basis of the clinical study, as pernicious anemia; another group of 14 cases is made up of those which were discharged, with a question as to the diagnosis. Of the 112 cases accepted as clinically pernicious anemia, 26 will be discussed as a separate group, since they presented, as a major manifestation, the important group of symptoms denoting involvement of the spinal cord. There are therefore, 86 cases left to be studied as cases typical of pernicious anemia.

Certain features, however, may best be discussed with reference to their occurrence on the basis of the total figures. Of the total number of cases, 134 in number, clinically regarded as pernicious anemia, 94 occurred in males and 40 in females, an incidence of 70 per cent. and 30 per cent. respectively. Of the 134 cases, 67 died in the hospital, 67 left the hospital: some of them no better, many improved and a few recorded as worse and leaving at their own request. The number of histories actually studied was 161; nine of the patients had records of two periods in the hospital and two each had three histories. The histories used covered a period from 1912 to the present time. Seven of the patients were under thirty years of age; 31 were between thirty and forty; 39 were between forty and fifty; 36 between fifty and sixty; 35 over sixty. Only 6 of the cases occurred in negroes; evidently the incidence of the disease in negroes is low; the percentage occurrence here is slightly under 5; it is safe to assume that the percentage of negro patients in the County Hospital is at least twice this figure. So far as statements could be obtained the disease had lasted, prior to admission to the hospital, less than six months in 28 cases, between six months and two years in 40 cases and more than two years in 34 cases.